

Water Sources for Public-Supply Wells in Three Fractured-Bedrock Aquifer Systems in Massachusetts

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Bruce P. Hansen

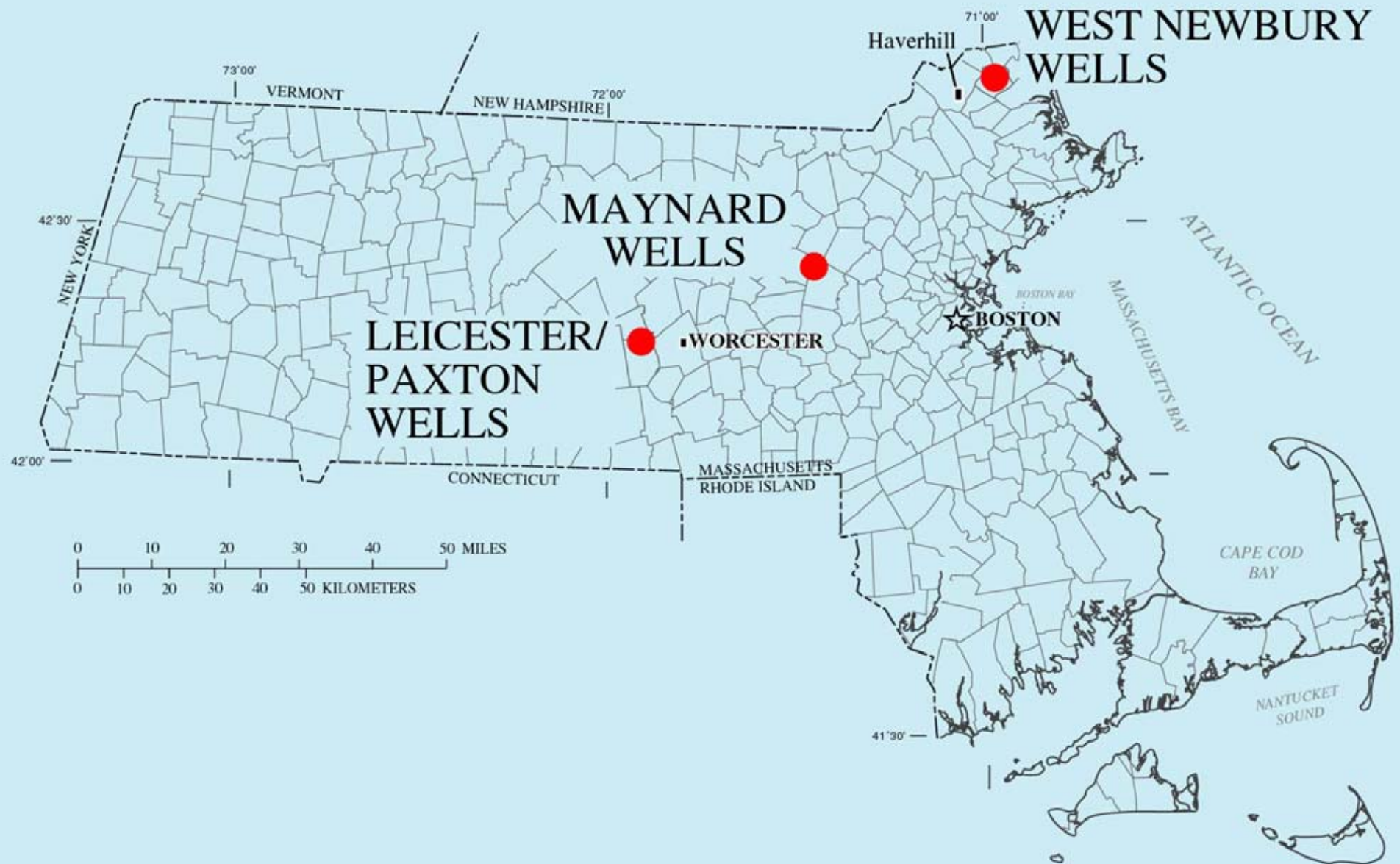
Cooperators: Massachusetts Department of Environmental Protection;
Massachusetts Department of Environmental Management



Purpose of Study

- Refine conceptual models and methods for determining sources of water for public-supply wells in crystalline-rock aquifer systems.
- Determine the effects of pumping from bedrock wells on streamflow and wetland water levels.

Study Areas



CONCEPTUAL SIZE OF CONTRIBUTING AREAS


Recharge or
Leakage Rate = .25 ft/yr

Recharge or
Leakage Rate = 2 ft/yr




Well

Discharge = 100 gal/min

0  1,000 FEET

CONCEPTUAL SHAPE OF CONTRIBUTING AREAS

**Low Yield or
Early Time**



**Water-bearing
Fracture**

**High Yield and
Late Time**



**Water-bearing
Fracture**

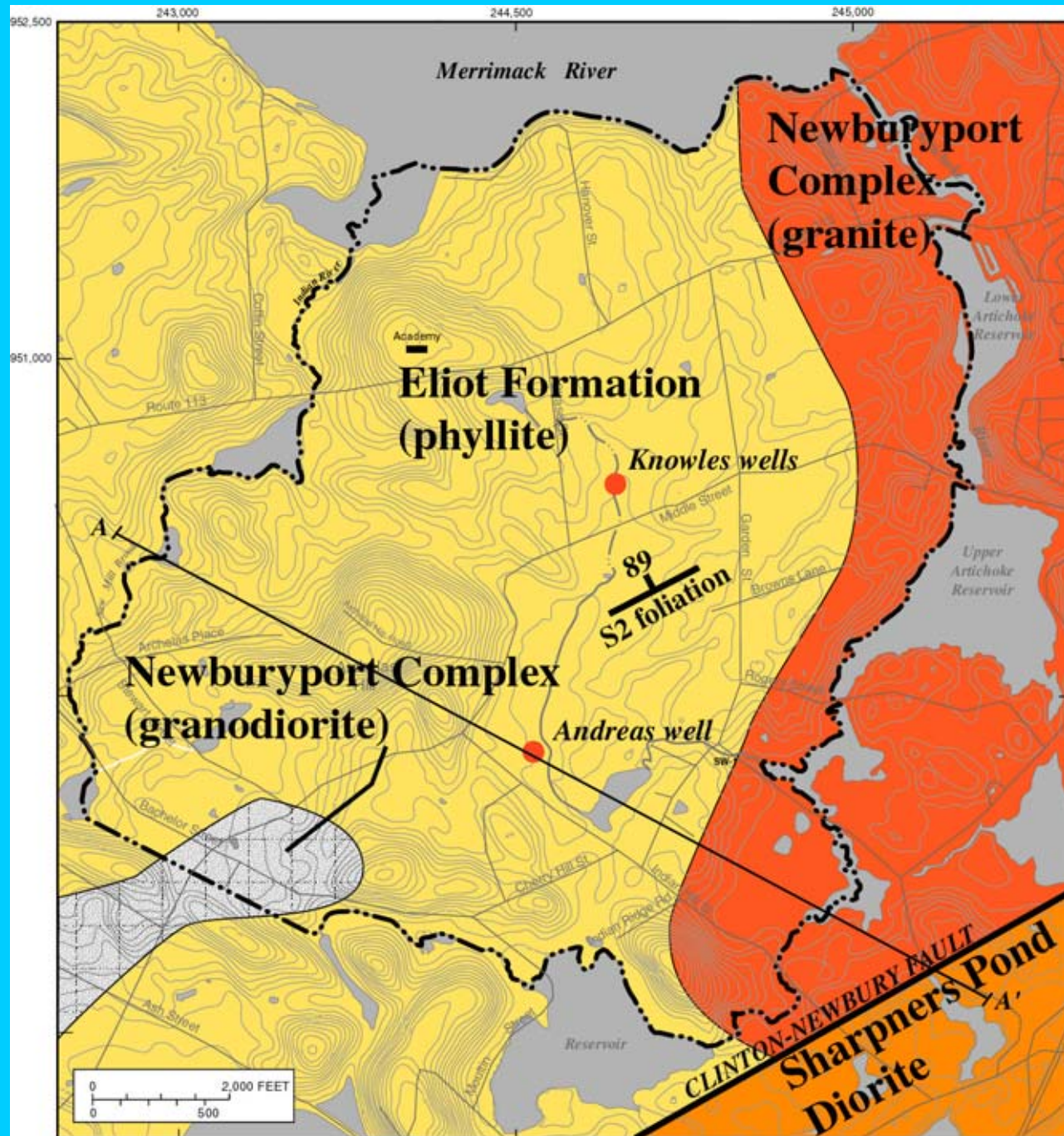
Project Activities

- Geologic mapping
- Installation of piezometers
- Borehole geophysics
- Hydrologic monitoring
- Aquifer testing
- Numerical modeling



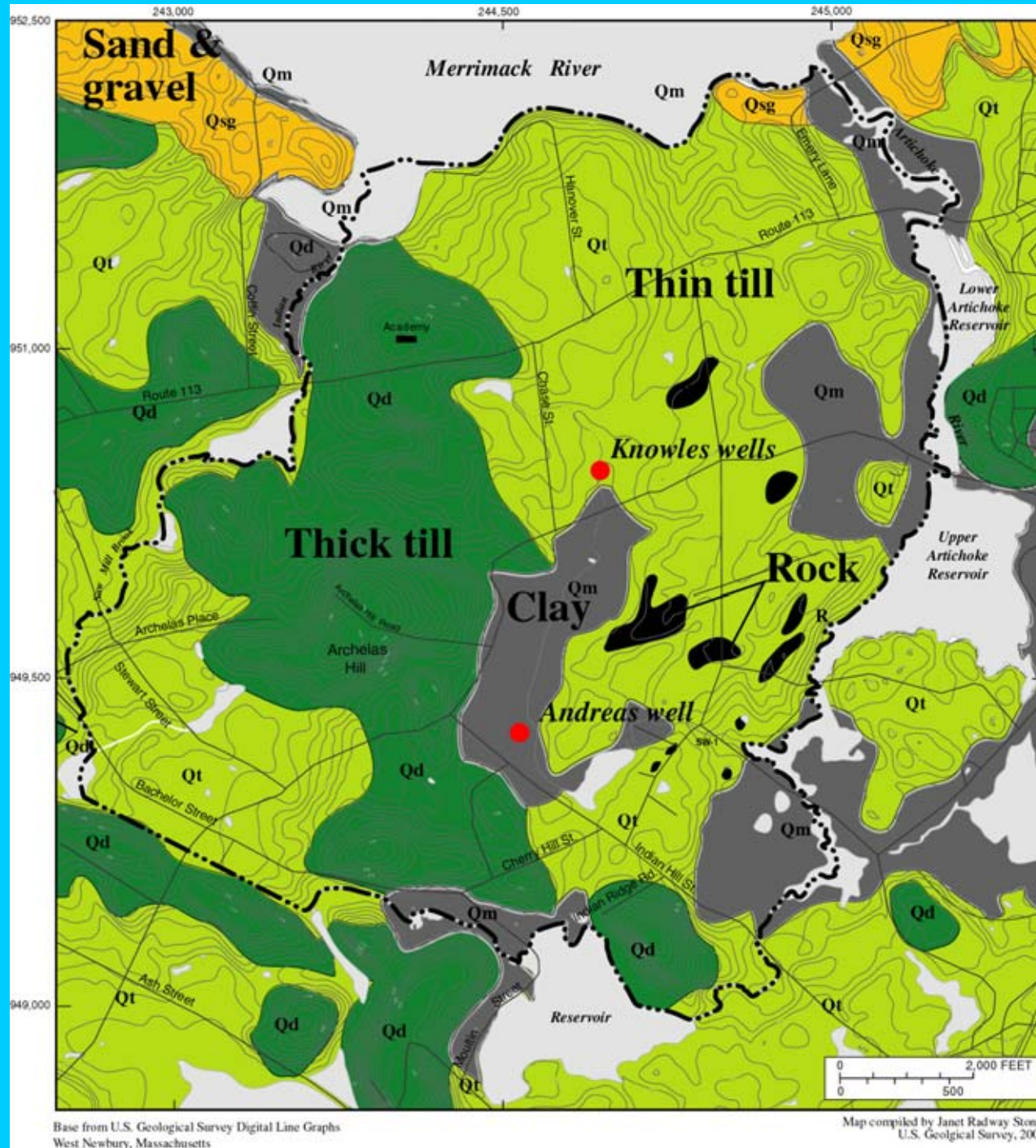


Bedrock Geology, West Newbury

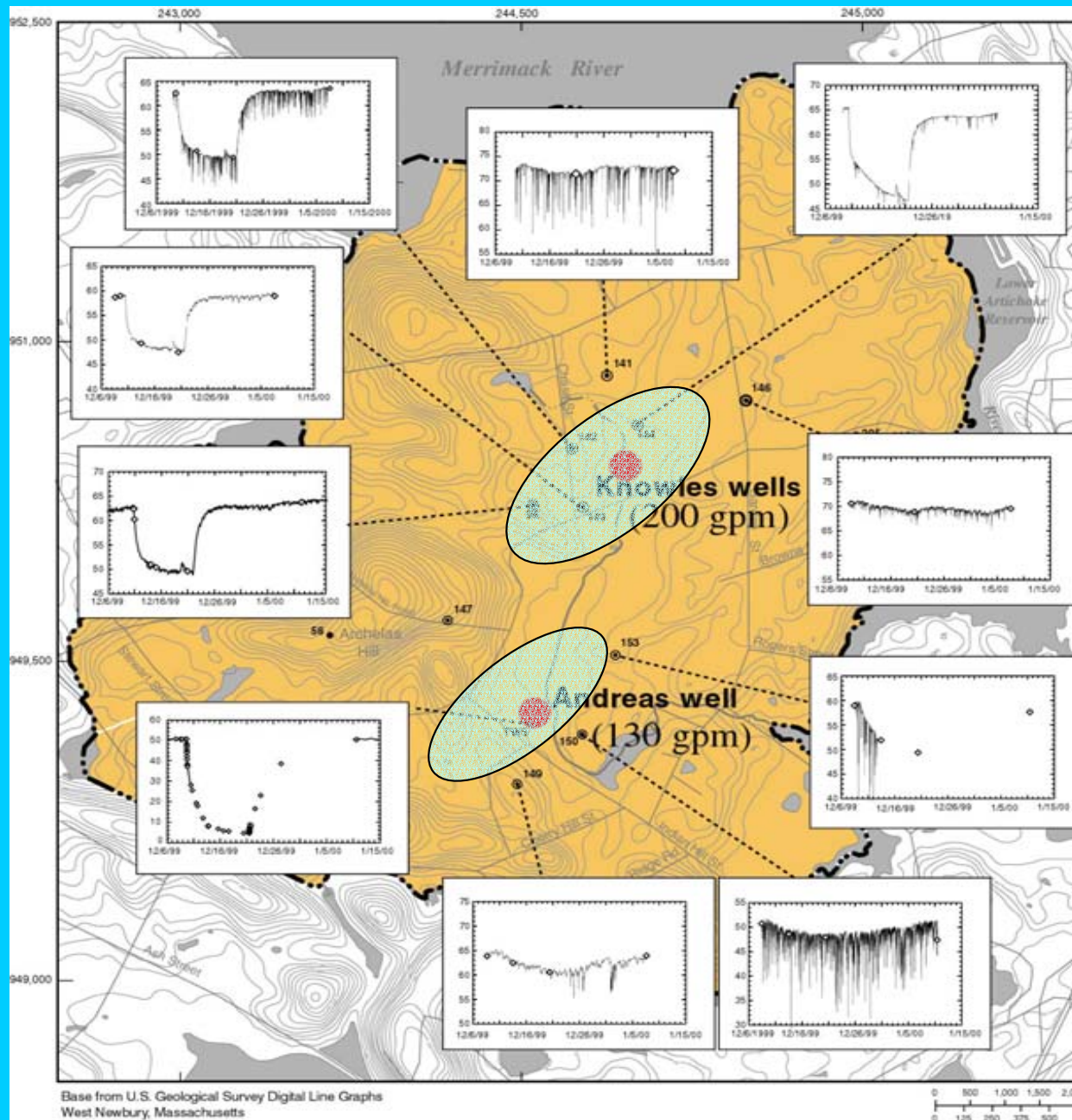


Base from U.S. Geological Survey Digital Line Graphs
West Newbury, Massachusetts

Surficial Geology, West Newbury

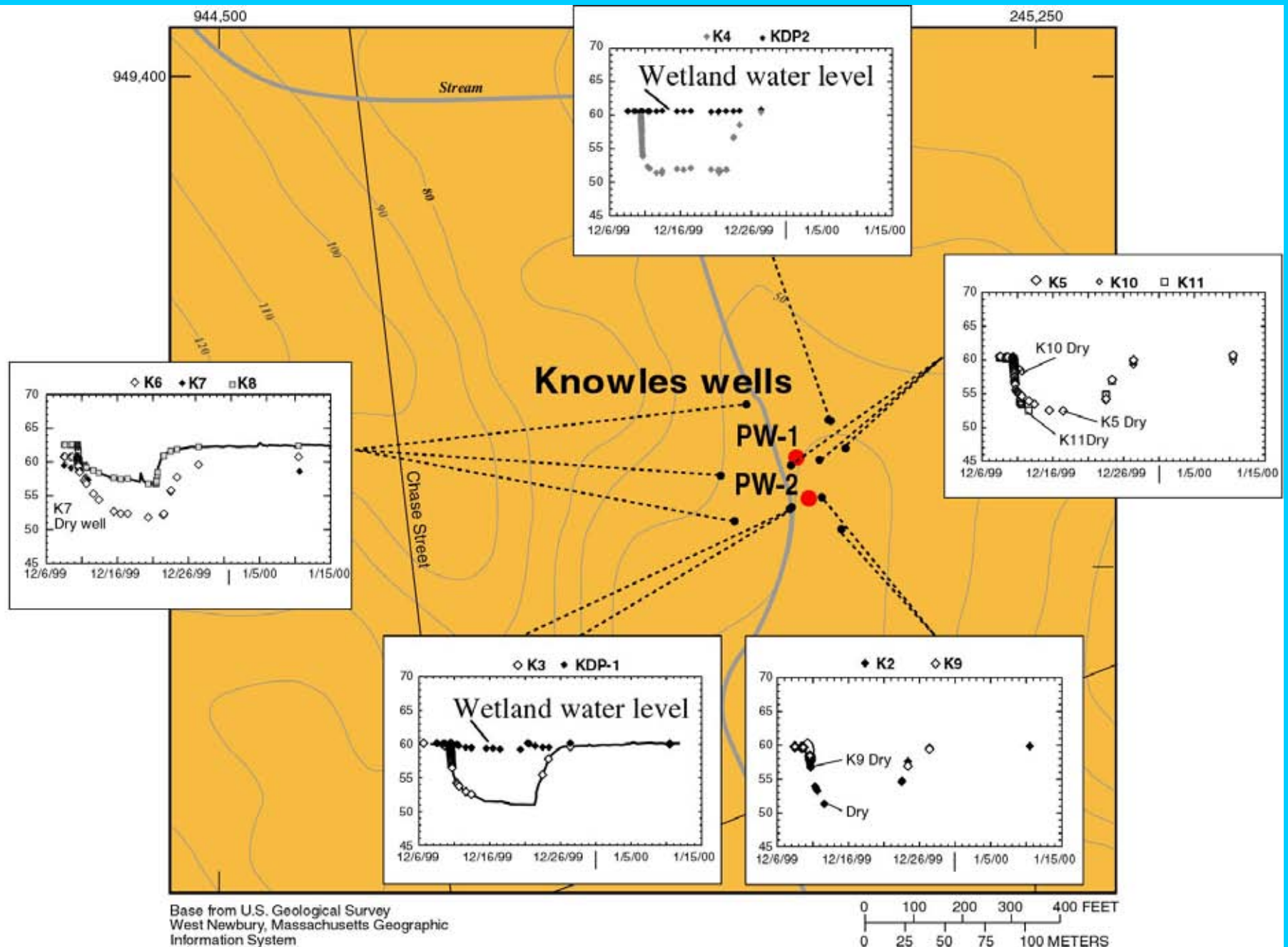


Pumping Responses in Bedrock Observation Wells



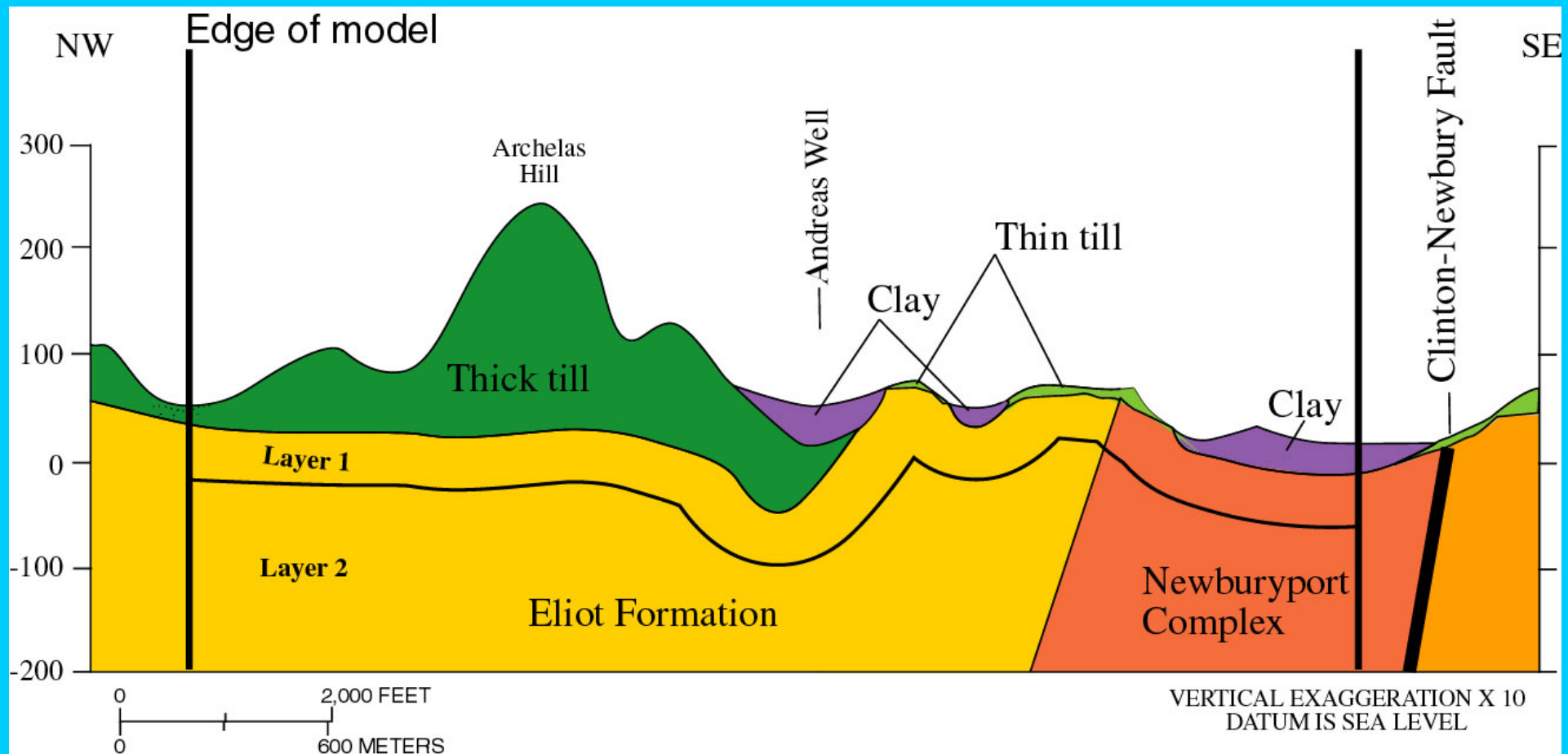
Drawdown >
10 feet

Pumping Responses in Piezometers

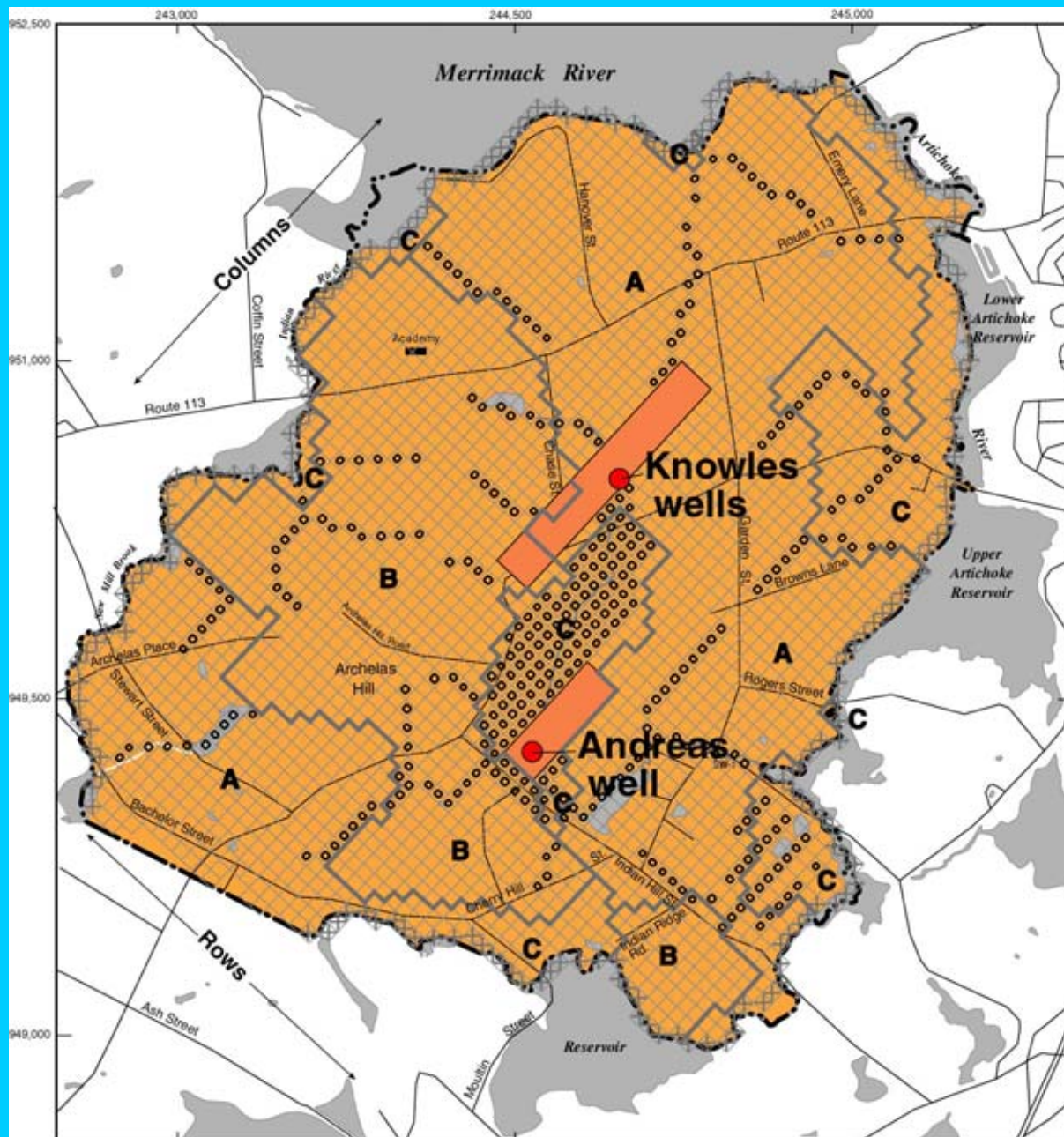




Model Layers, West Newbury



Model Features



Base from U.S. Geological Survey Digital Line Graphs
West Newbury, Massachusetts

TRANSMISSIVE ZONE

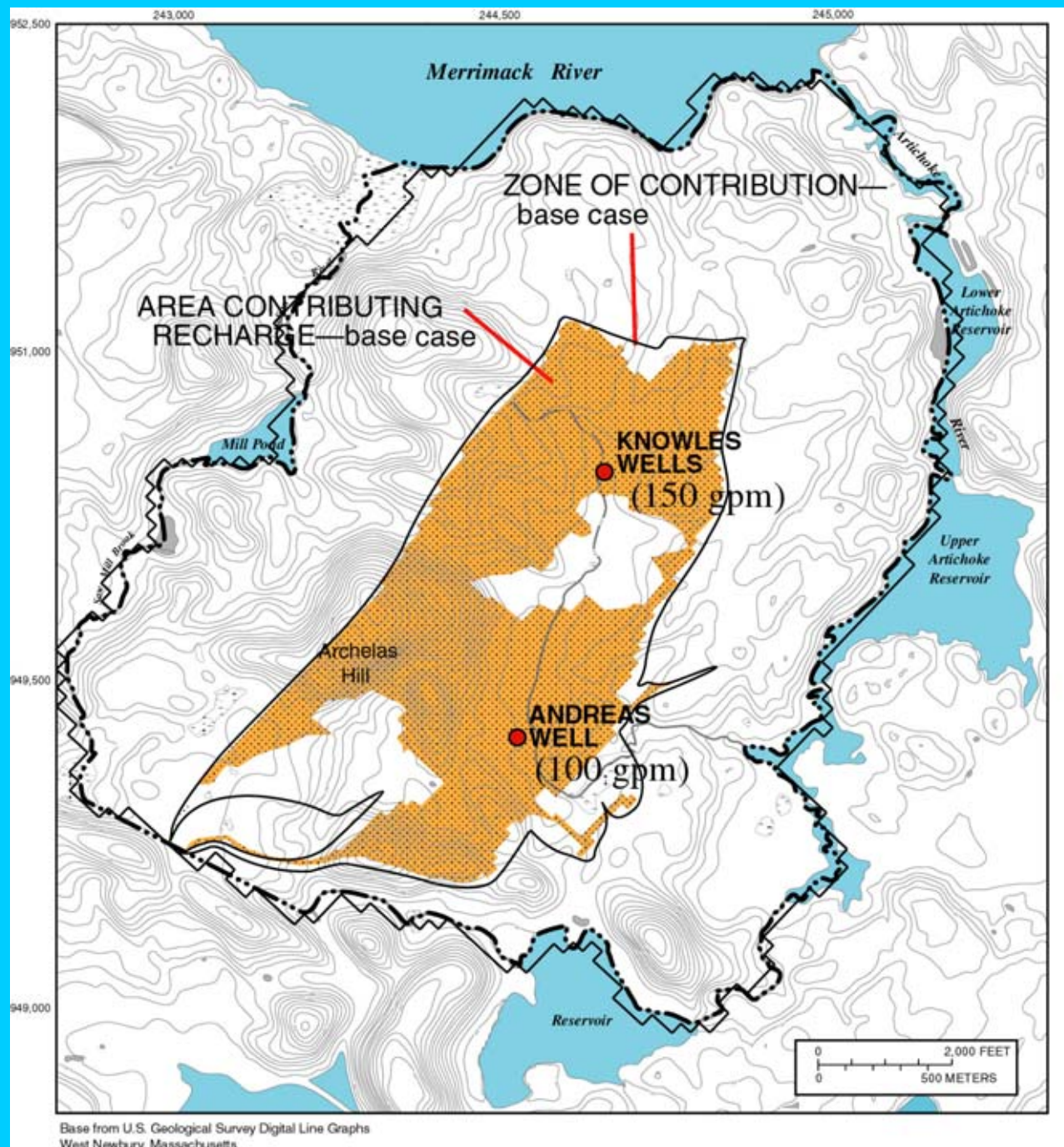
CONSTANT HEAD **DRAIN**

RECHARGE ZONES

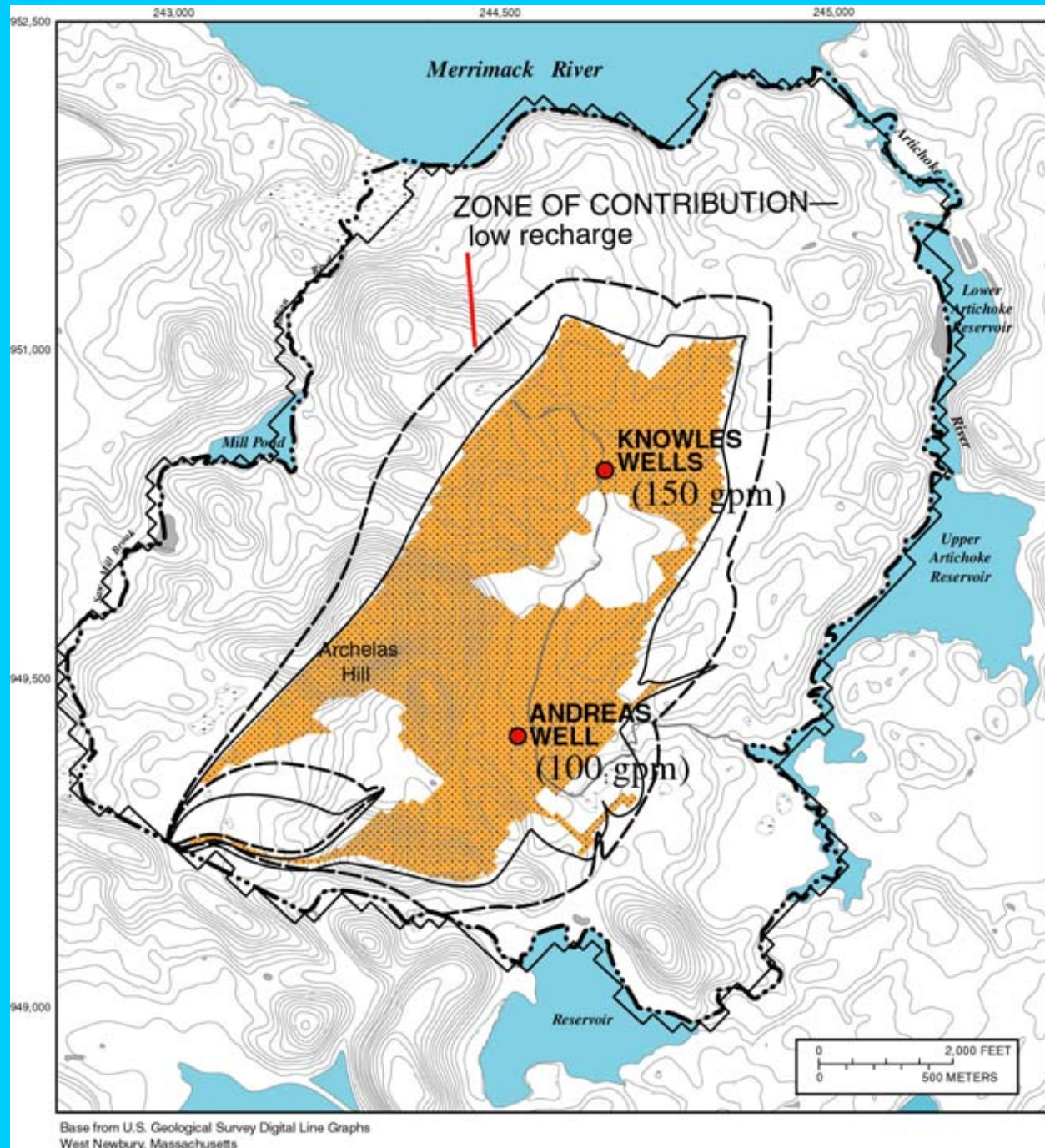
A Thin till
B Thick till
C Marine clay

0 2,000 FEET
0 500

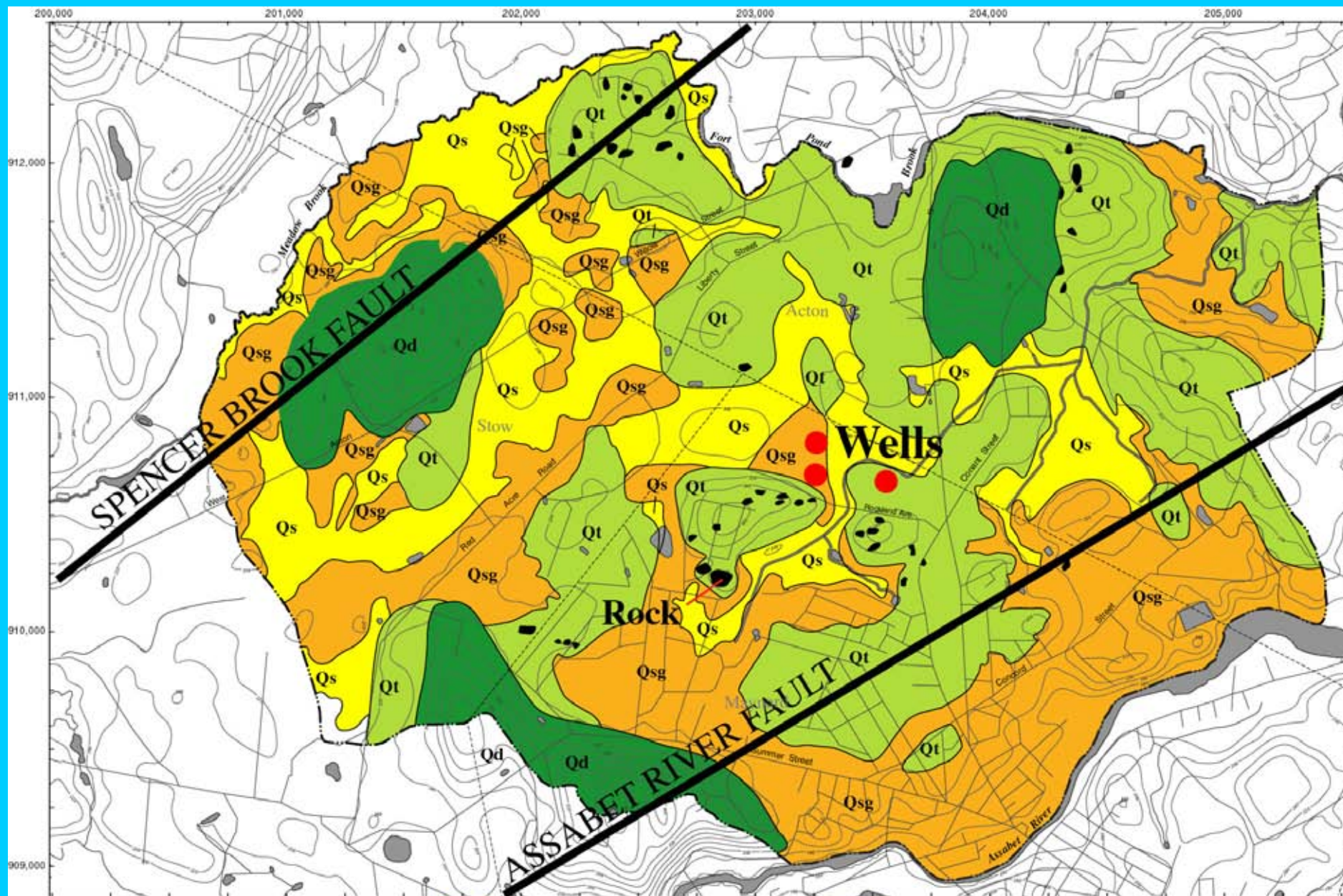
Contributing Areas, West Newbury



Contributing Areas, West Newbury



Geology, Maynard



Base from U.S. Geological Survey Digital Line Graphs
Maynard, Massachusetts

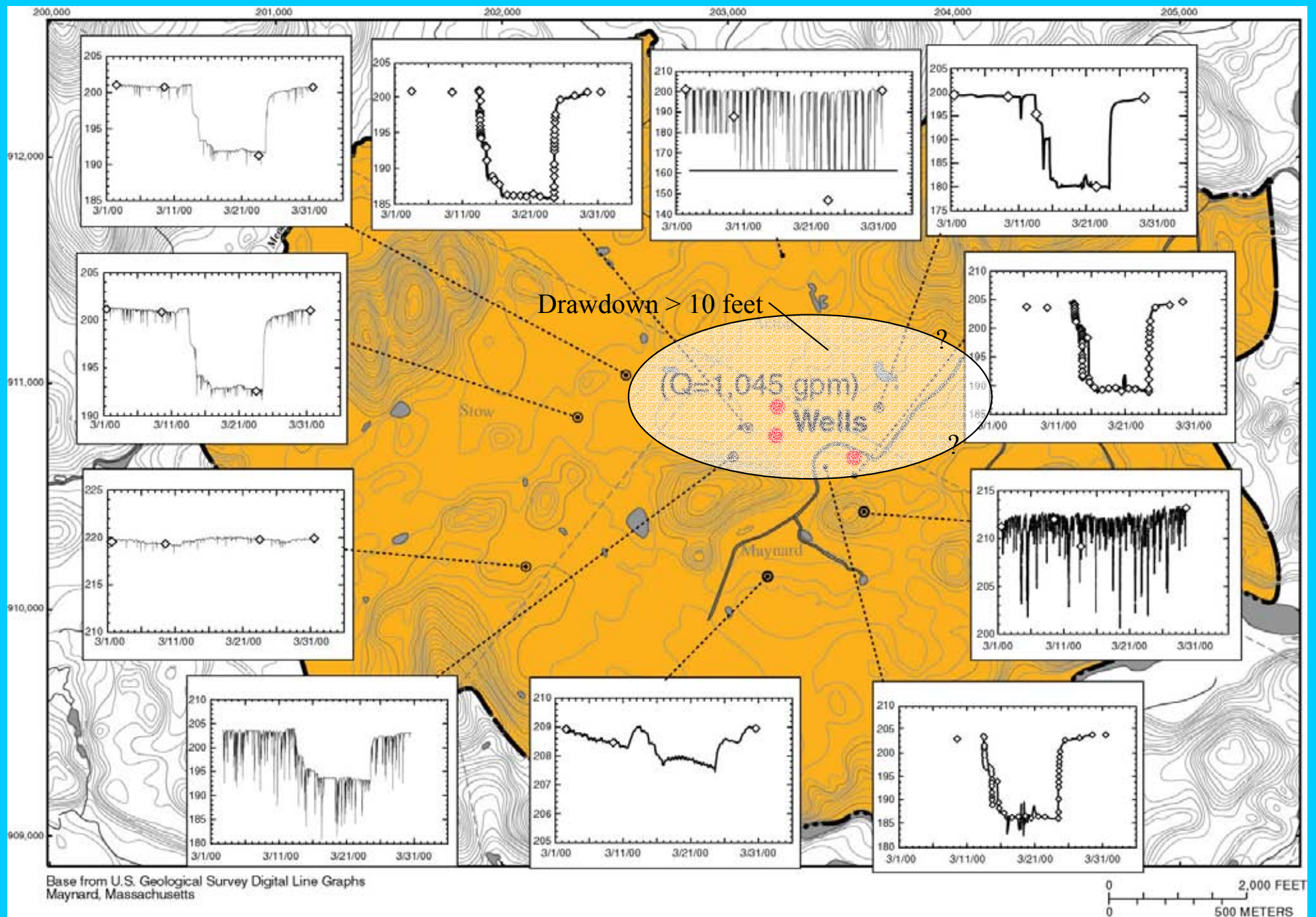
Qs	SWAMP DEPOSITS	Qt	THIN TILL
Qsg	SAND AND GRAVEL	Qd	THICK TILL
Bedrock - Nashoba Formation (Schist and gneiss)			

Modified geology from Hansen, 1956

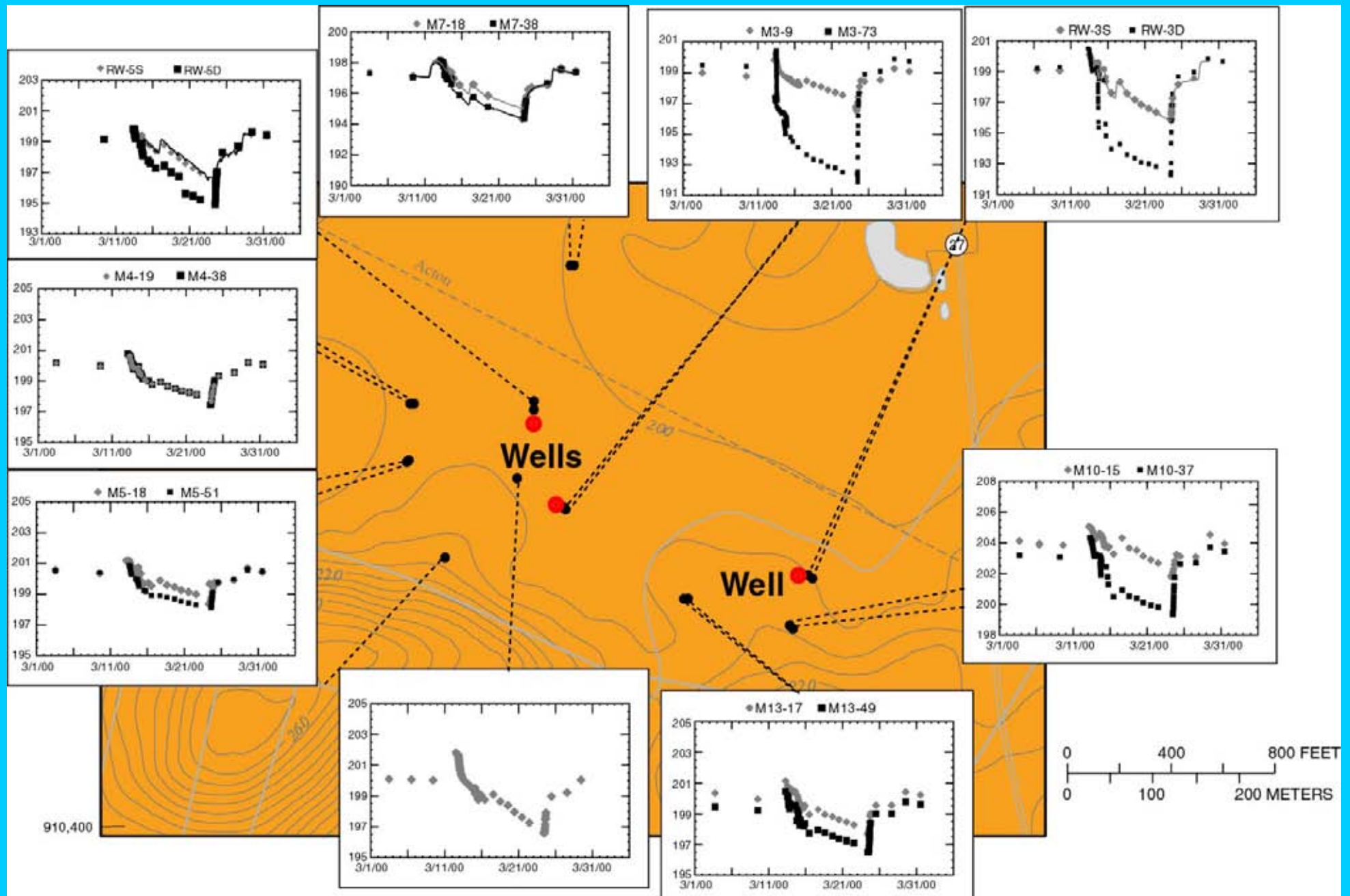
0 300 600 METERS
0 1,000 2,000 FEET



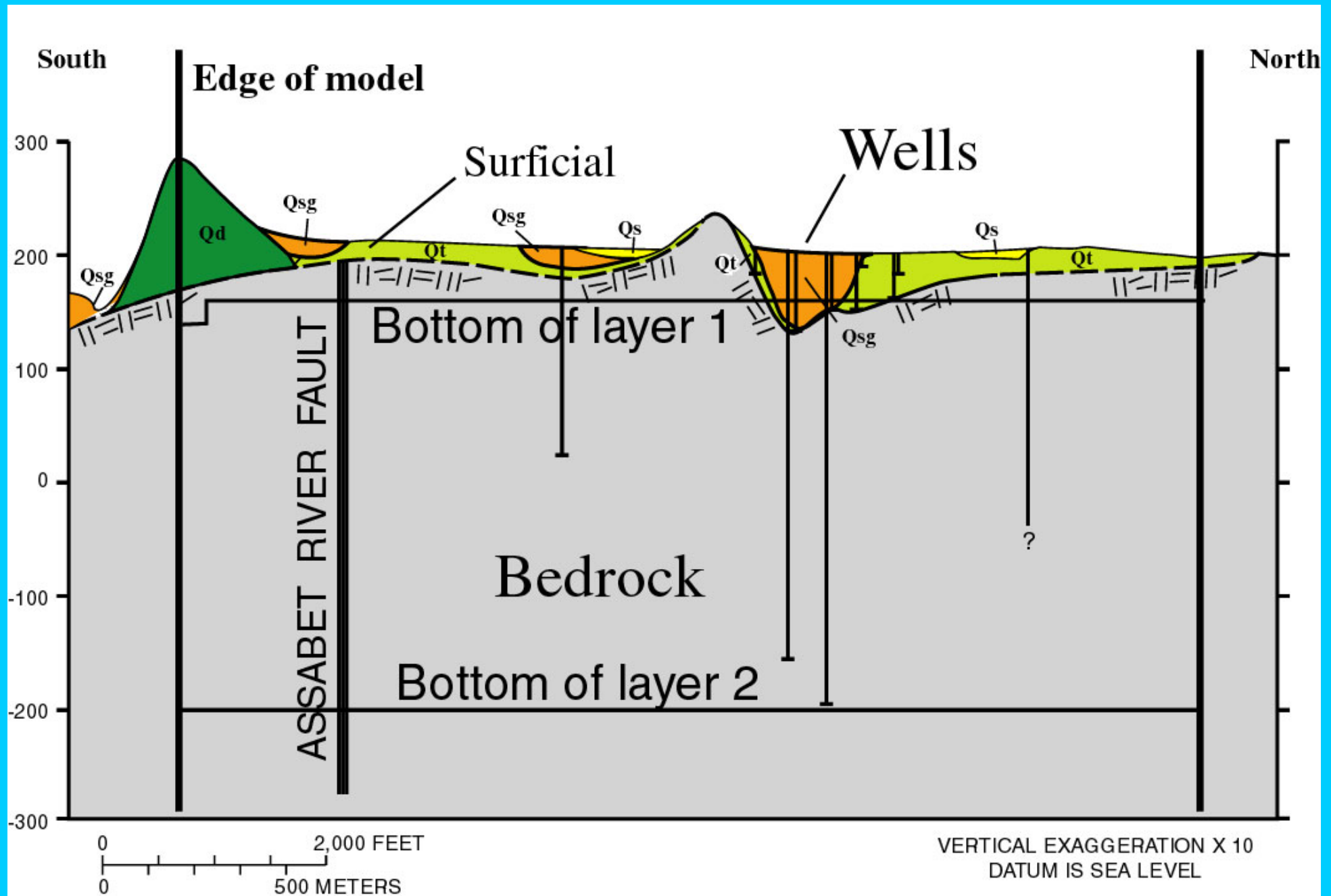
Pumping Responses in Bedrock, Maynard



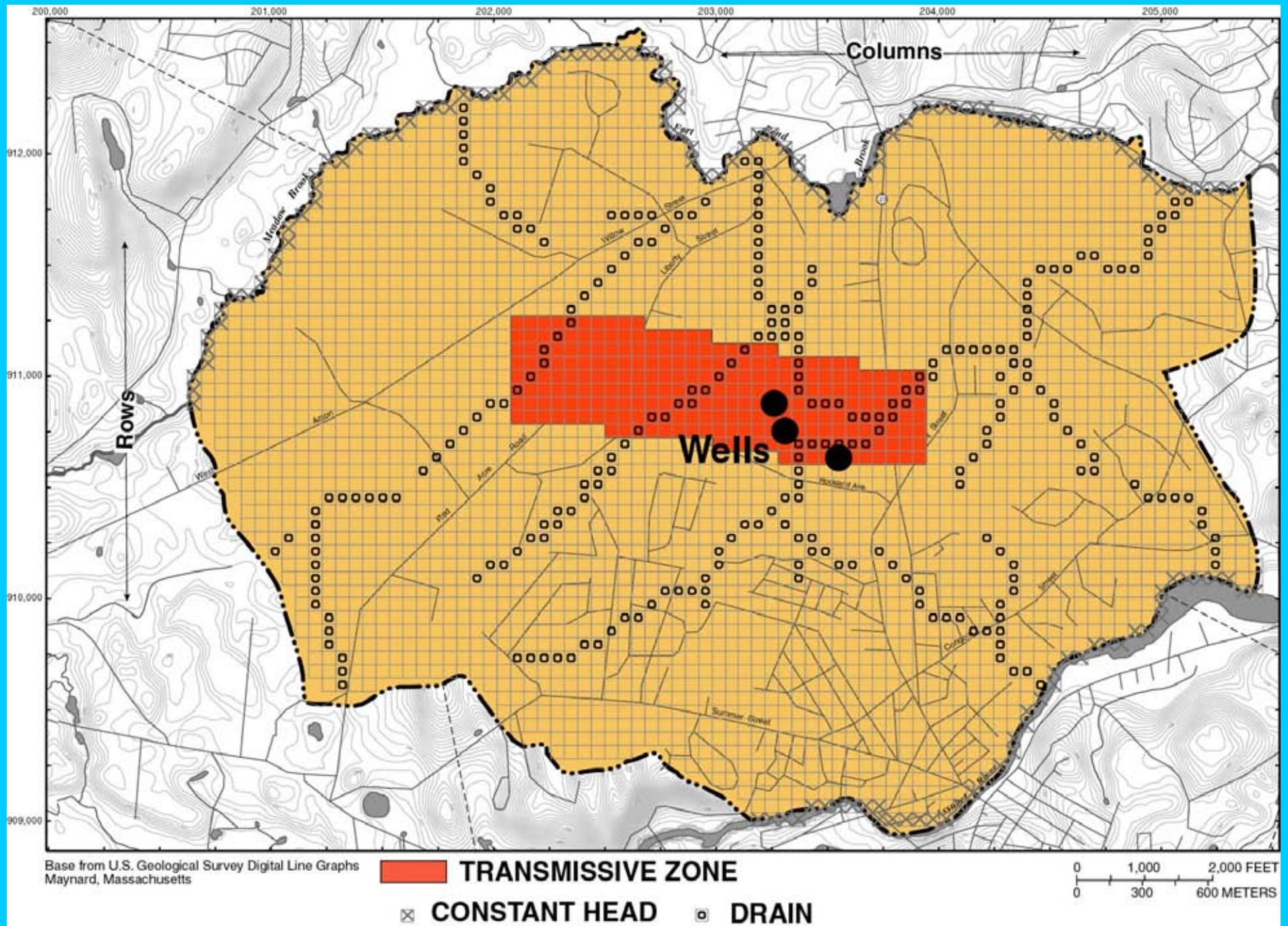
Pumping Responses in Piezometers, Maynard



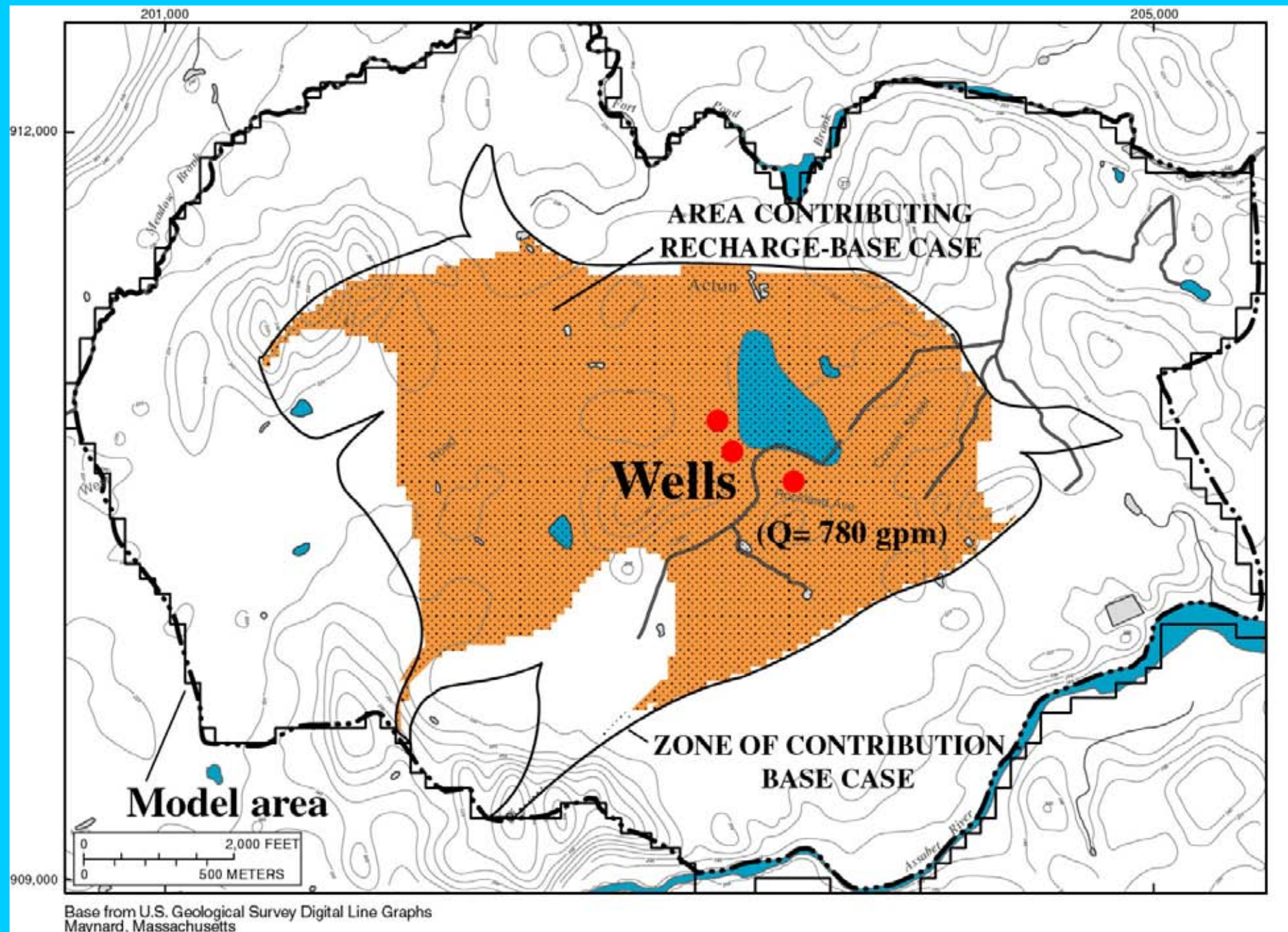
Model Layers, Maynard



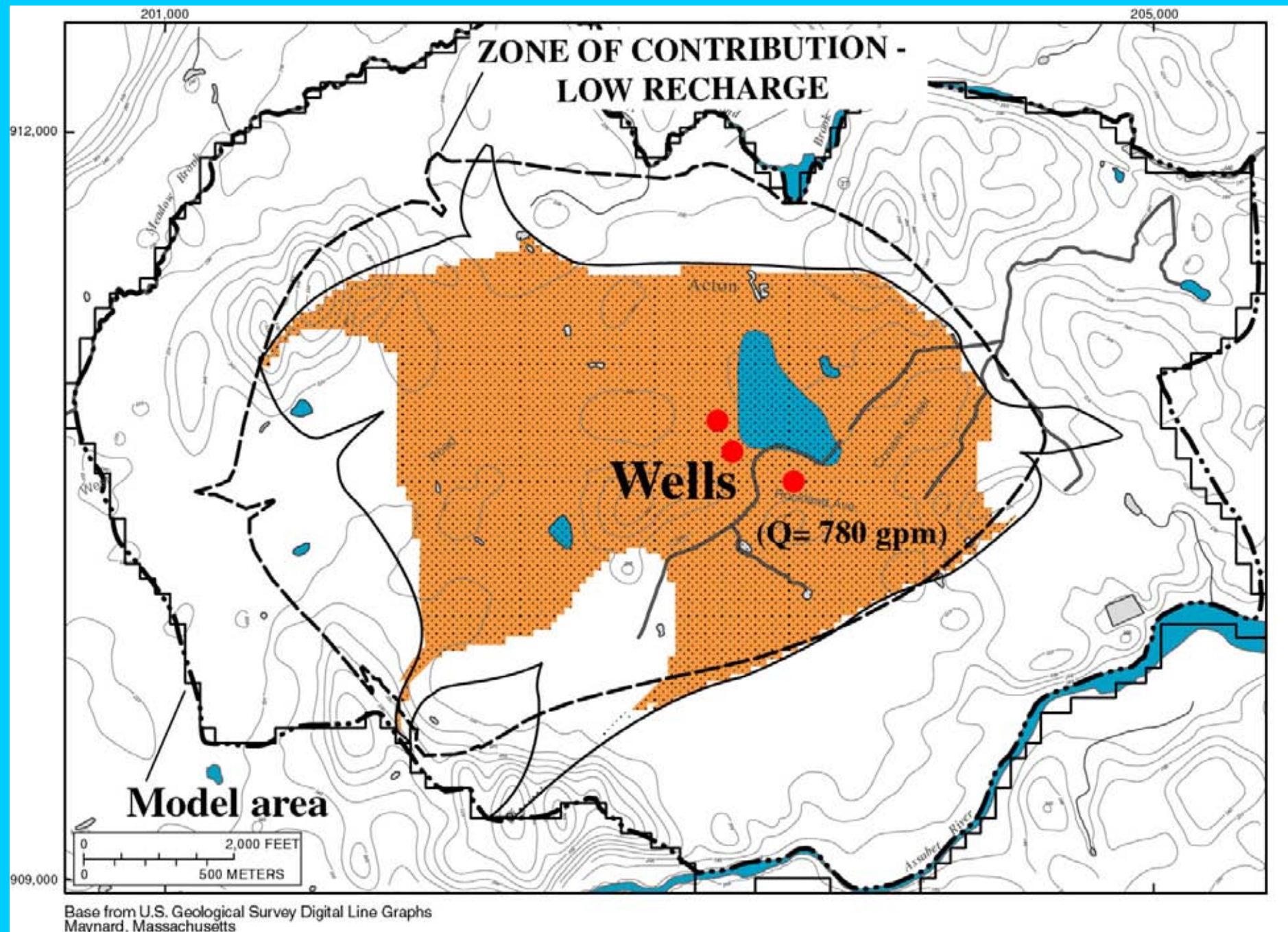
Model Features, Maynard



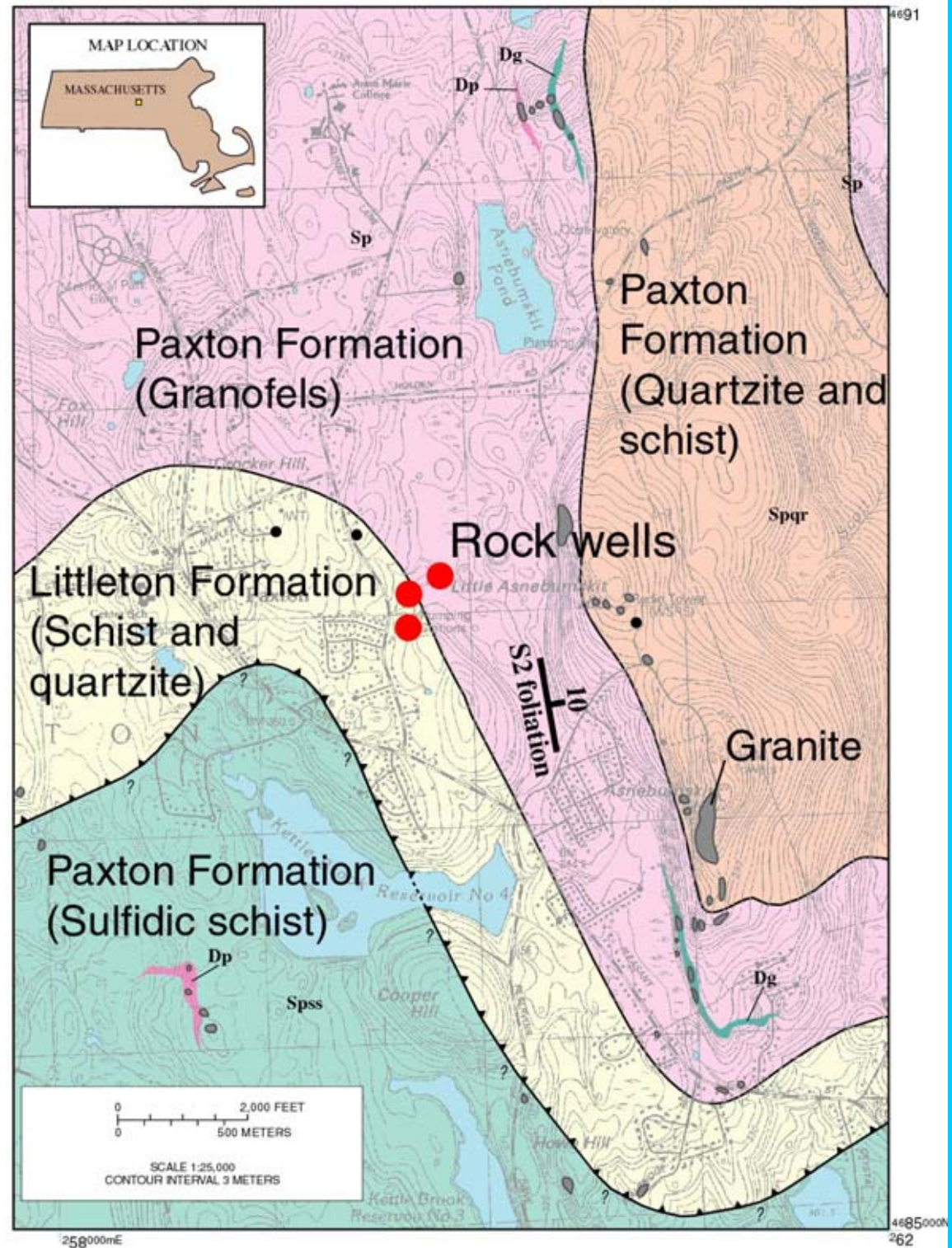
Contributing Areas, Maynard



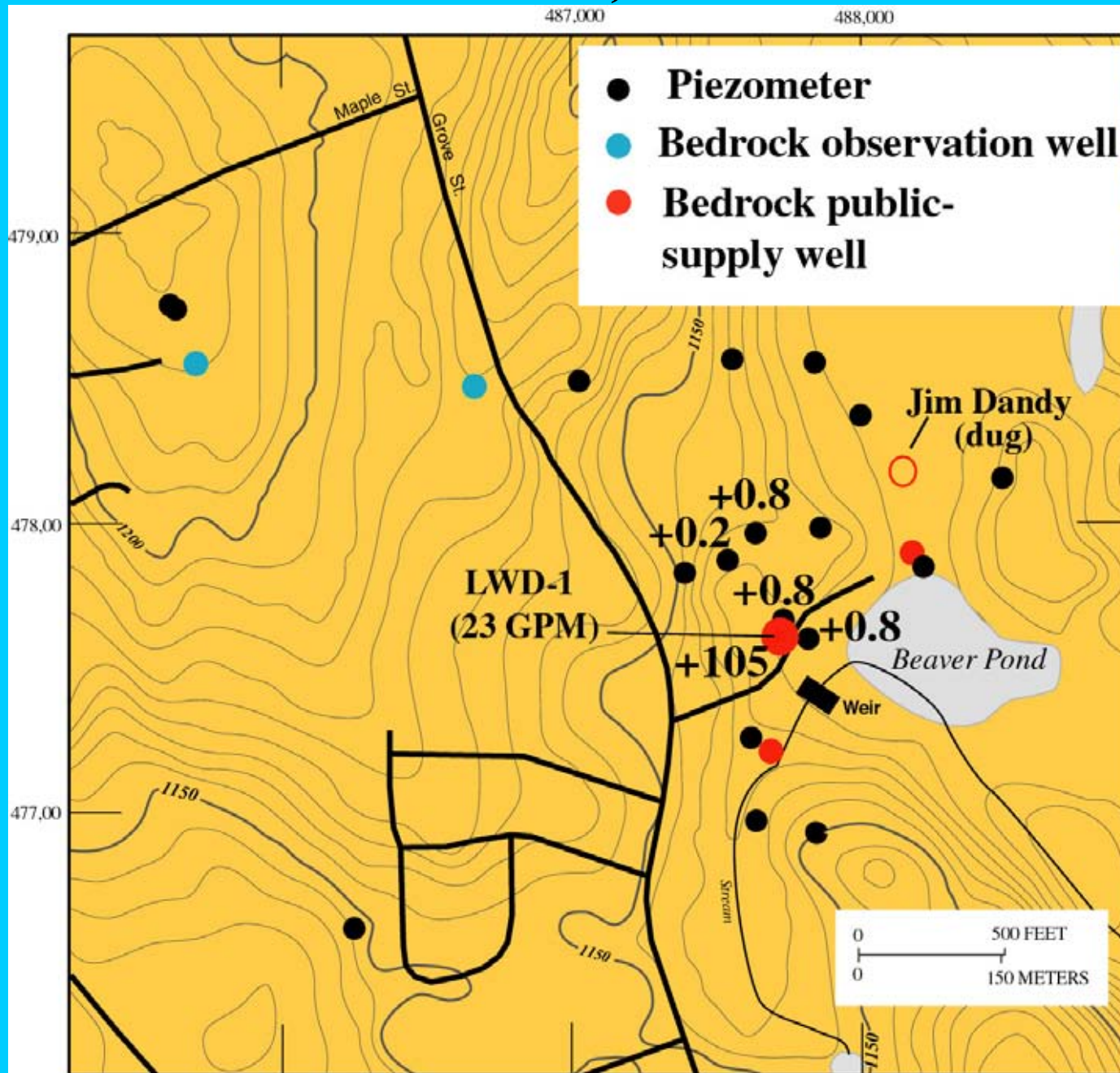
Contributing Areas, Maynard



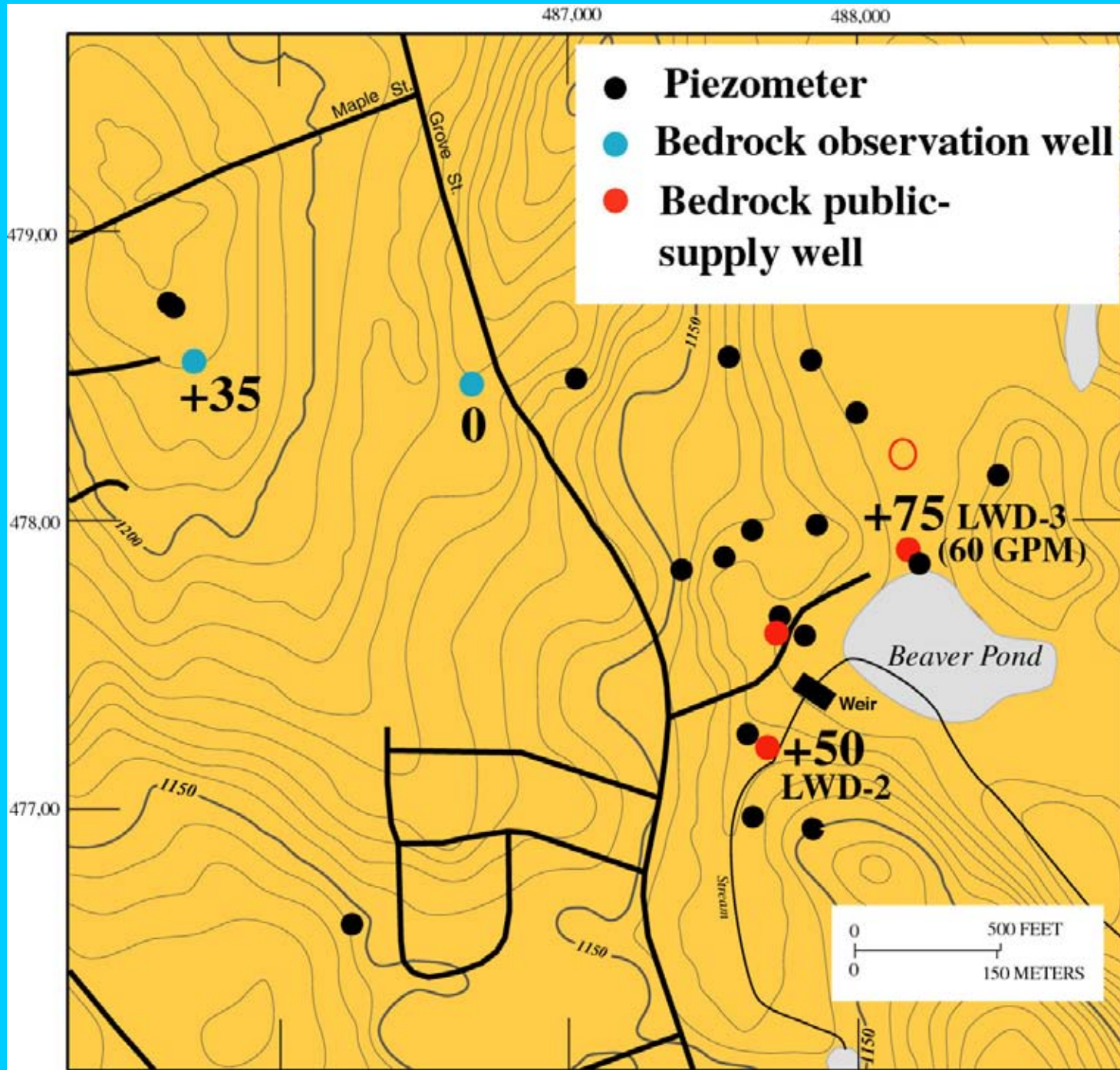
Bedrock Geology, Paxton



Water-Level Recovery (Feet) in Shallow Well and Piezometers, Paxton

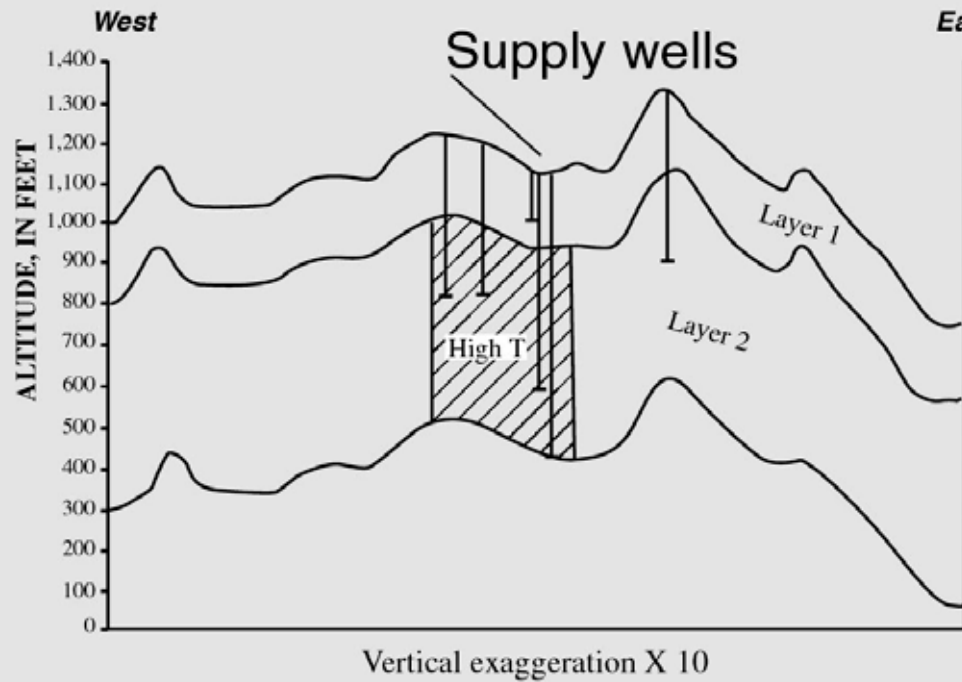


Water-Level Recovery (Feet) in Deep Wells, Paxton

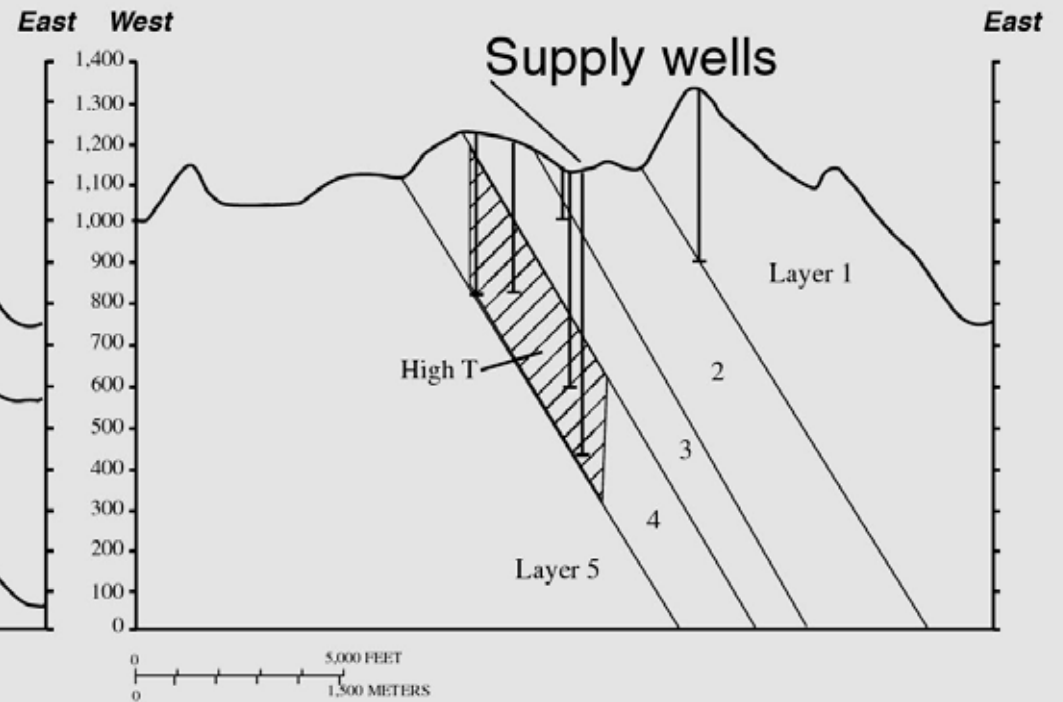


Model Layers, Paxton

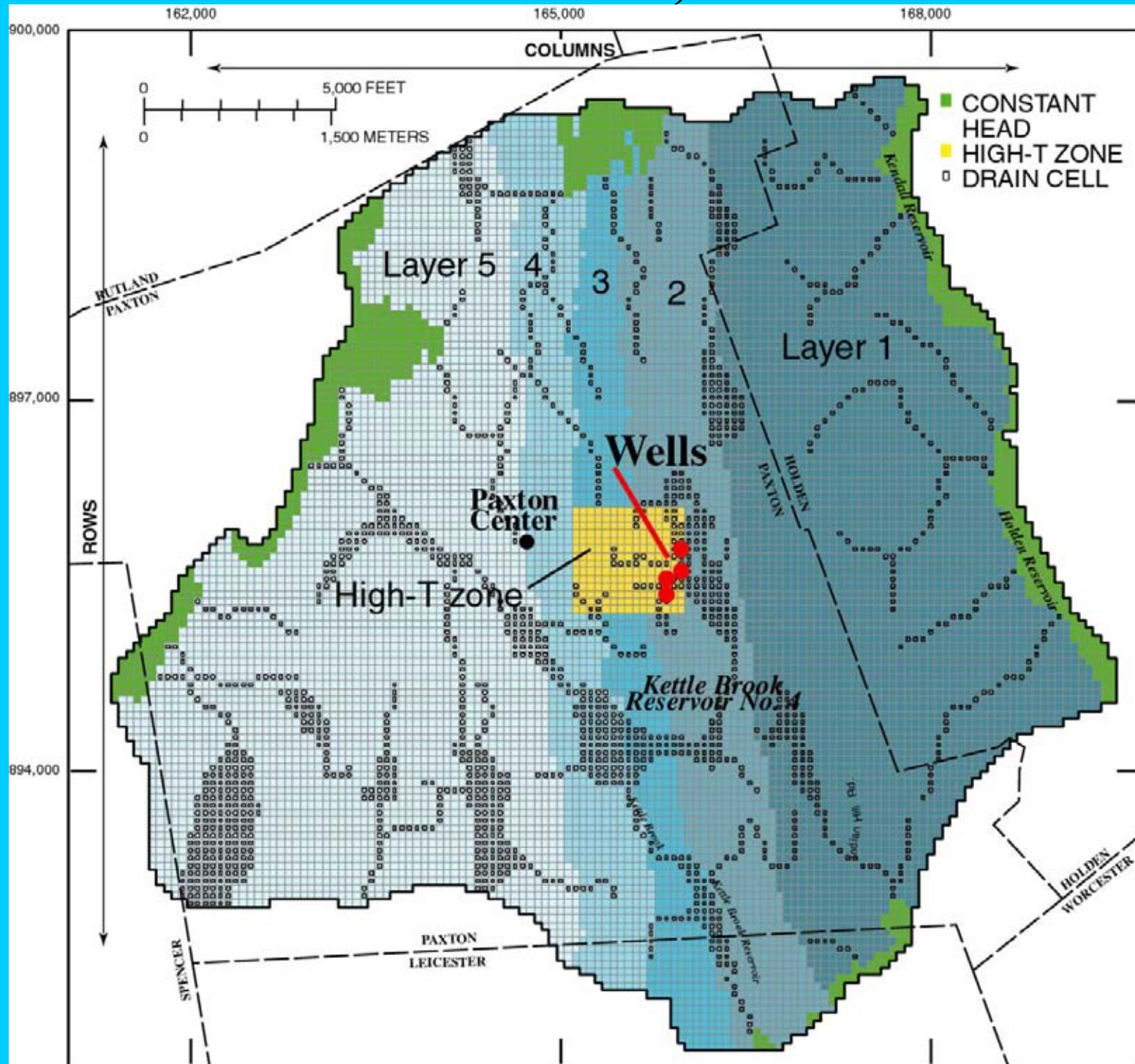
2- Layer Model



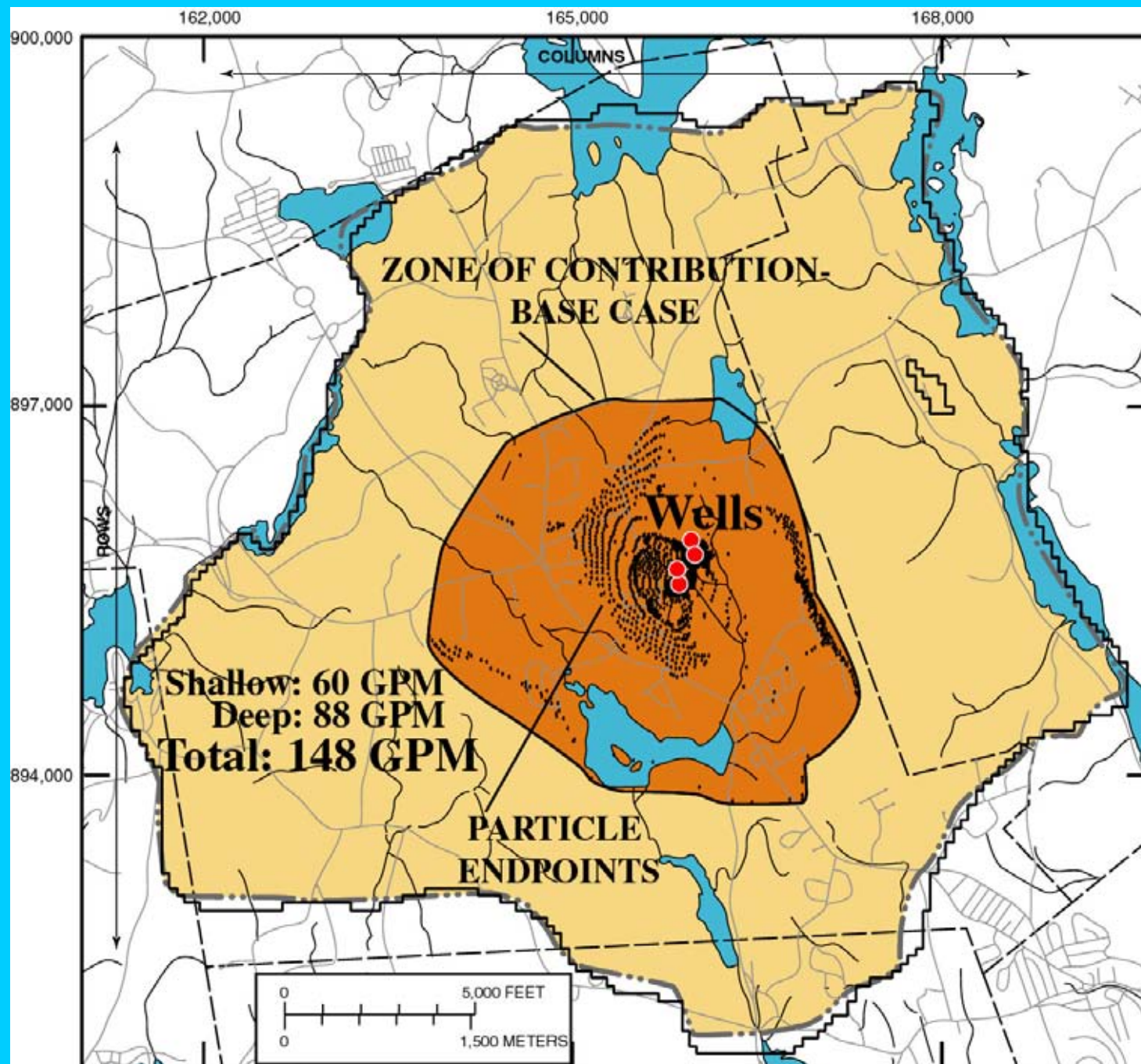
5- Layer Model



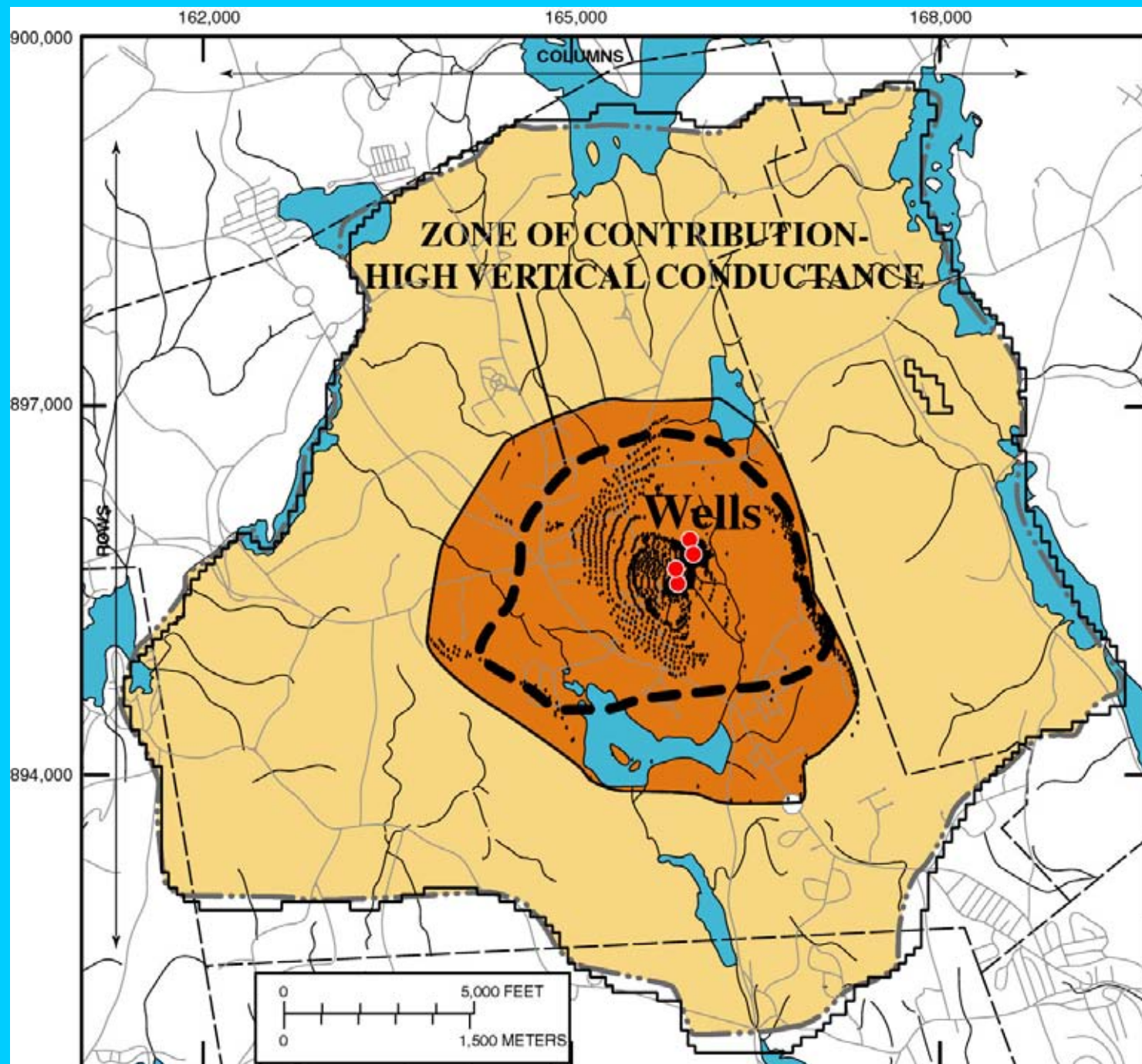
Model Features, Paxton



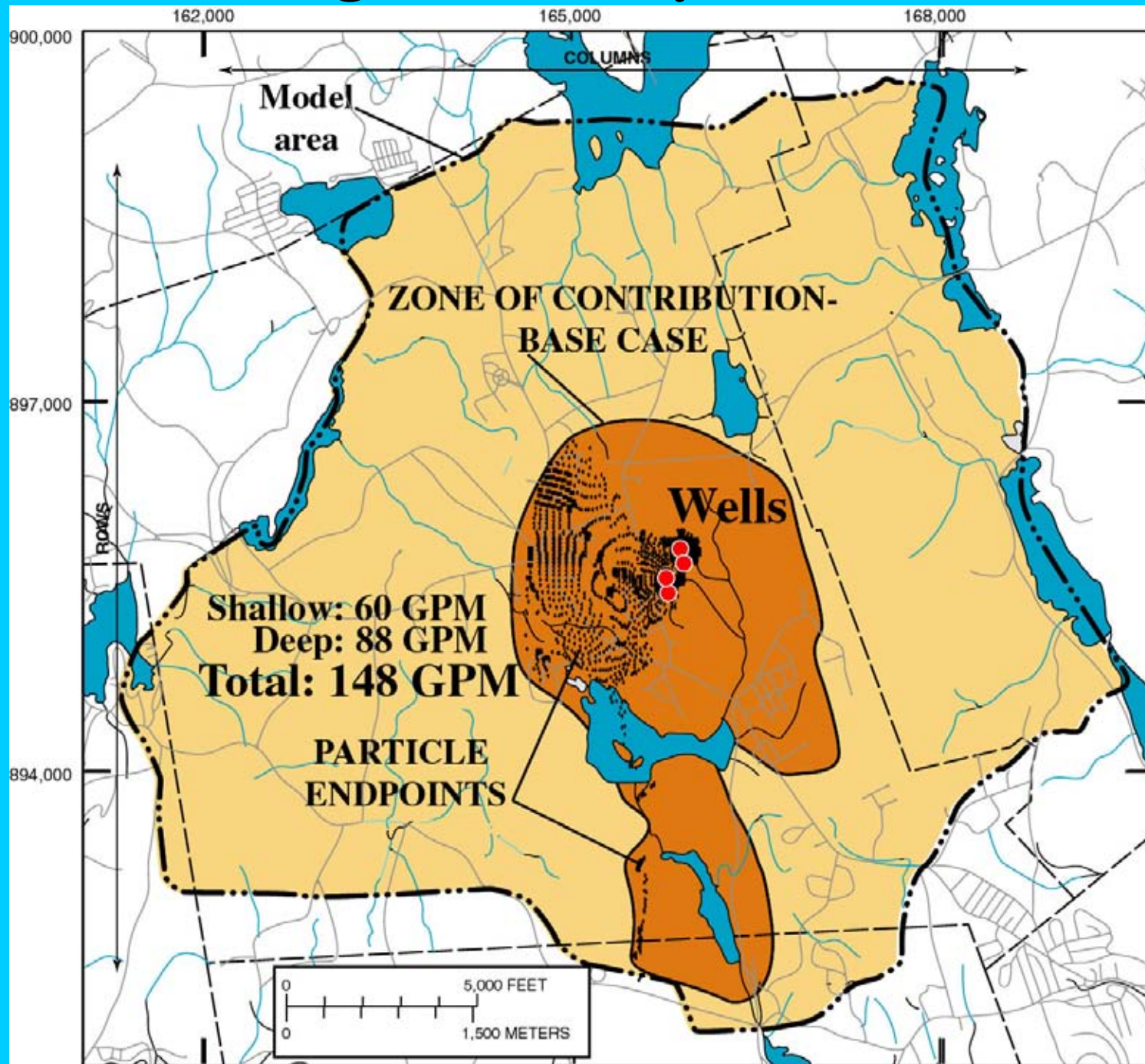
Contributing Areas, 2-Layer Model, Paxton



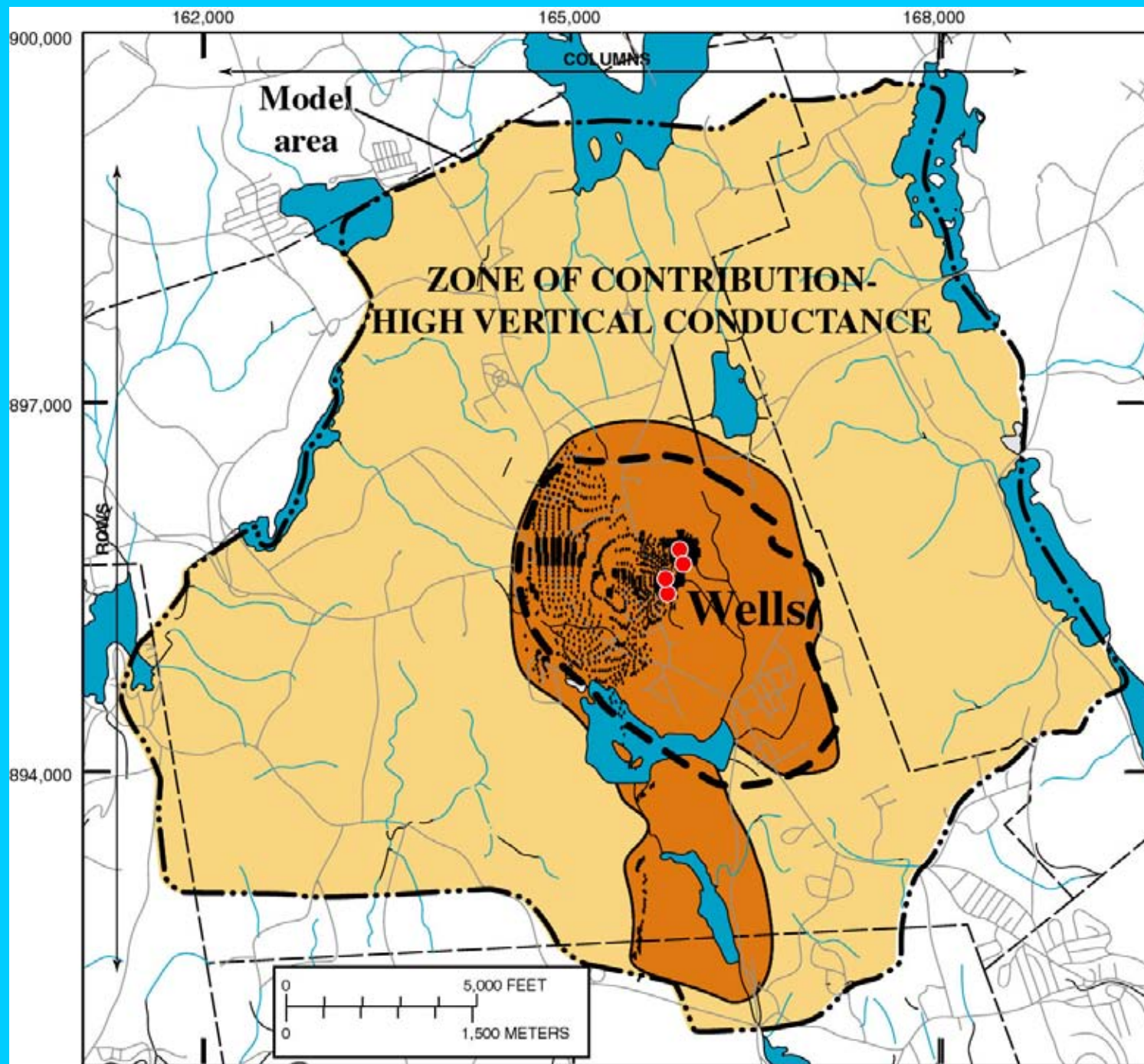
Contributing Areas, 2-Layer Model, Paxton



Contributing Area, 5-Layer Model, Paxton



Contributing Area, 5-Layer Model, Paxton



Information Needs

- Annual and seasonal recharge rates in upland areas for pumped crystalline-rock aquifers.
- Hydraulic properties from geologic information.
- Vertical hydraulic conductivity in till/bedrock systems.

IDEALIZED PIEZOMETER NETWORK FOR BEDROCK AQUIFER TEST

